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ABSTRACT

Recent research in text structure and comprehension has several important implications for readability theory and practice. First, text-level factors such as coherence and organization must be considered along with word-level and sentence-level factors when evaluating the readability of a specific set of materials or when attempting to construct parallel experimental passages of equal difficulty. Second, it is clear that a single-minded application of any factor to all ages and ability levels is likely to be ineffective, because such things as the ability to select the main idea and the ability to make intersentential inferences develop during the school years. Third, the formula approach must be modified; for it is clear that such easily measurable factors as sentence length and number of syllables are not necessary determinants of comprehensibility. Moreover, these formulas provide teachers with little useful information about what can be done to increase student comprehension and retention. Finally, it must be noted that text structure alone cannot determine readability. All considerations of readability must also include reader-related factors such as prior knowledge, attitude, and motivation. (RL)

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Text Structure and Comprehension:

New Directions for Readability*

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Text Structure and Comprehension:

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Though factors such as sentence length and number of syllables have often been shown to be insufficient causal determinants of readability (see Irwin, 1978), other measurable readability factors have not, until recently, been available. More specifically, recent research indicates that an examination of text-level factors such as coherence and organization might provide readability information not included in word-level or sentence-level analyses. Thus, the purposes of this paper are to summarize current research linking text-level structural characteristics with comprehensibility and to suggest the implications of this research for readability theory and practice.

Coherence

Several recent comprehension models have stressed the relationship between coherence and comprehension (Frederiksen, 1977; Hindyard and Olson, 1978; Thorndyke, 1976; and others). Coherence can be loosely defined as what it is that distinguishes a text from a disconnected group of unrelated ideas. Kintsch and Van Dijk (1978) have suggested a measure of coherence which, in initial data, correlated .62 with readability, defined as reading time per proposition recalled, and .59 with recall completeness (Kintsch, 1979). Basically, this measure provides a count of the number of instances in which input sets of propositions do not contain an argument already retained in short-term memory.

Other data which supports the relationship between such a measure and readability have been presented by Kintsch and Vipond (1977). They found that the number of inferences which they predicted would be necessary to link propositional coherence graphs correctly predicted the direction of the differences among several passages in terms of the reading times and numbers of saccades, fixations, and regressions. It should be noted that in this study, as well as in Kintsch (1979), this new coherence value was a better predictor of readability than a standard readability formula (Flesch, 1948).

Another variable reported in Kintsch (1979) which may provide some measure of coherence is the total number of different arguments contained in the propositional text base of a given text. More different arguments would result in less coherence. Kintsch, Kozminsky, Streby, McKoon, and Keanan (1975) found that the number

of word concepts in a passage was significantly related to reading times and recall completeness when the total number of words and propositions in the text was controlled. Similarly, Entin and Klare (1978) report that, in a factor analysis of three correlation matrices of readability variables, a third factor found (after the word-level and sentence-level factors) was the number of different words used in the passage.

Several recent studies have also indicated that coherence may be established by semantic relations other than repeated propositional arguments. Carpenter and Just (1977) found that reading times on a target sentence were significantly shorter when that sentence followed a sentence using a verb that directly entailed a noun phrase in the target sentence. Stone (1979) replicated these results using longer prose passages. Haberlandt and Bingham (1978) found that reading times were shorter for sentences following sentences with verbs that were semantically related.

Another possible system for analyzing the coherence of a text is the "cohesion" analysis system presented by Halliday and Hasan (1976). This system includes the grammatical relations of reference (personal, demonstrative, comparative), substitution, ellipsis, and conjunction as well as lexical relations such as exact reiteration and collocation. Moe (1979) has suggested that such a system is likely to be related to psychological coherence and, therefore, to comprehensibility. Irwin (1979b) attempted to examine the possible relationship between readability, as defined by Kintsch and Van Dijk (1978), and cohesion, as defined by Halliday and Hasan (1976), by creating parallel texts with one version containing twice as many cohesive

ties as the other. The results indicated that the subjects reading the cohesive version had significantly lower reading-time-per-proposition-recalled ratios and performed better on a prompted recall test than did subjects reading the non-cohesive version.

Moreover, at least four other potential readability factors can be conceptually linked to the idea of coherence. First, the "relational density hypothesis" states that the probability of the recall of any idea is partially a function of the number of other ideas in the text to which that idea is related. It has been supported by the results of two studies (Gaesser, 1978): In the first, relational density predicted the recall patterns written by college students immediately after reading; in the second, this hypothesis predicted oral recall patterns collected an hour after reading. If this theory is correct, then it can be predicted that highly coherent texts will be remembered better than less coherent ones.

Secondly, the compactness of subtopic structure has been linked to recall completeness in a study involving sixth-grade students (Aulls, 1975). Topical structure is defined as the "referential connections between statements in a paragraph in terms of each statement's reference to a main topic ans subsets of statements to a specific subtopic" (p. 392). When subtopics occur consecutively, they are said to be compact. Clearly, a compact subtopic structure would result in a passage that is more coherent than a passage with a discontinuous subtopic structure.

Thirdly, there is some evidence that the presence of irrelevant information may interfere with comprehension. It could be hypothesized that irrelevant information reduces the coherence of a text.

Thorndyke (1979) found that presenting a condensed version of a news story in which irrelevant information was deleted resulted in better recall of the story than did presenting the entire story. Bruning (1970) found that prompted recall of target sentences was greater when those sentences were presented in a relevant context than when they were in an irrelevant context.

Finally, the explicitness of conjunctive concepts has also been linked to comprehensibility (Irwin, in press, b). By definition, when conjunctive relationships between sentences are comprehended, the passage will appear to be more coherent than when they are not comprehended, and recent research indicates that these relationships are more likely to be comprehended when they are stated explicitly. Marshall and Glock (1978) found that subjects from a community college reading a passage in which conditional relations were implicit recalled less of the total passage and fewer of the conditional relations than did similar subjects reading a parallel version in which the conditional relations were explicit. Irwin (in press, a) found some limited evidence that comprehension of a causal connective is associated with a higher level of recall of the connected ideas, and Irwin (1979a) found that the comprehension of causal connectives may be reduced when they are made implicit.

All of this evidence seems to indicate that one or more measure of coherence would provide useful readability information. This measure would reflect the extent to which sentences are conceptually linked, though it is presently unclear whether this measure should include shared arguments alone, shared arguments along with other semantic relations, a cohesion analysis, a measure of relational

density or subtopic compactness, a count of the amount of irrelevant information, an analysis of the number of implicit inter-sentential relations or some combination of all of these.

Organization

Another way of describing text structure is by analyzing larger organizational factors. Indeed, the distinction between coherence and organization is unclear. If one defines coherence as what links sentences to each other, one might describe organization as the abstract structure to which all the sentences are simultaneously linked. Thus, by definition, organization can also be said to contribute to coherence, because all sentences are ultimately linked to each other by their relationship to this abstract structure.

The reader's familiarity with the type of organizational pattern in a text seems to be a potential factor in comprehensibility. In research involving a story grammar describing conventional plot structures, Thorndyke (1977) found that recall was a function of the amount of plot structure in the story and that repeating the same story structure in a second passage facilitated the recall of that passage. Stein and Nezworski (1978) examined the effects of the degradation of their story grammar on college students' free recall and found that recall was "a direct function of the match between the text structure of stories and an ideal story structure" (p. 190). Kintsch (1977) has reported a study which examined the effects of scrambling the order of events in a story. Though it took significantly longer to read the scrambled version, judges of the written summaries could not distinguish between the subjects in the two conditions, indicating that the subjects in the scrambled condition were using the extra

time to reorganize the story according to an internalized organizational pattern. Finally, Kintsch and Greene (1978) studied college subjects' recall of a story that corresponded to a predicted story structure and their recall of an Indian story which did not correspond to the predicted story structure. They found that the recall of the "macro-propositions", or gist, was severely distorted after five retellings for the Indian Story only, therefore concluding that comprehension and recall of stories is facilitated by the availability of an appropriate structural cognitive schema.

If it is true that comprehension is facilitated when the organizational pattern matches an abstract orgarizational schema already known to the reader, then knowledge of these common organizational schema could make an important contribution to readability determinations. Several possible story structures are available (Kintsch, 1977; Stein and Nezworski, 1978; Thorndyke, 1977; and others), but descriptions of expository patterns are less accessible. Meyer (1978) has suggested that the available schemata for prose organization will probably correspond to the "rhetorical predicates" described by Grimes (1975). In a study involving ninth-grade students, she found that subjects who used the author's rhetorical predicates recalled more information from the passages than the students who did not use these patterns and that students who used this organizational strategy were better able to discriminate between new consistent and intruded information than were the students who did not use this strategy.

Other recent studies have found differential effects for different kinds of organizational patterns. Kulhavy, Shmid, and Walker (1977) found that conceptual and temporal patterns did not result in different

levels of recall, but that the subjects reading the conceptually organized passage performed better than those reading the temporally organized passage when conceptual cues were used during recall. Sasson (1971) found that recall of sentence pairs was generally superior when there was a thematic connection, but that temporal connections resulted in better memory for dates. Thus, it might be concluded that the form and content of the desired recall would determine the optimal organizational pattern.

Several studies have compared the comprehensibility of name and attribute forms of organization with conflicting results. Some have found that name organization results in better recall (Divesta, Schultz, and Dangel, 1973; Yekovich and Kulhavy, 1976) and others have found that attribute organization results in better recall (Meyers, Pezdek, and Coulson, 1973; and others). The superiority of attribute patterns seems to disappear, however, when serial cues are not available (Meyers, et al., 1973). Shimmerlik (1978) points out that the materials in these studies varied in terms of such things as content and the availability of other cues and concludes that the superiority of attributive organization seems to depend on the structure of the materials and the specific task involved.

Moreover, the explicit presence of superordinate information has also been linked to comprehensibility. Fishman (1978) and Christie and Schumacher (1978) both report results indicating that an early presentation of superordinate information resulted in higher scores on a recognition test. Greeno and Noreen (1974) conducted a study in which the type of relation among sentences was either categorical, hierarchal, or linear ordering. They found that it took less time to

read sentences preceeded by superordinate sentences in the hierarchically organized group, but no such effects were found for the other organizational patterns. Gardner and Schumacher (1977) presented a passage in either a superordinate or subordinate context and found that the superordinate context resulted in higher recall scores only when a less rigorous scoring method was used, concluding that such a context does not aid in the accurate recall of details. Gagné (1969) also varied the type of context for five target facts in a science lesson and found prompted recall to be superior for the subjects in the superordinate-context condition. However, he also found that the subjects in a no-context condition scored higher than any other group and attributed this to contextual interference in the other conditions. Thus, more research is needed to determine the specific situations in which a superordinate context facilitates comprehension.

Finally, the location of the presentation of superordinate information may also mediate its relationship to readability. Dooling and Mullet (1973) varied the location of the presentation of the theme in a difficult passage. Free recall was superior for the group reading the theme before the passage, but the performance of the after-passage and the no-theme groups did not differ. Similar results indicating the superiority of early introduction of a theme have been found by others (Dooling and Lachman, 1971; Brown, Smiley, Day, Townsend, Lawton, 1977). Gagné and Wiegand (1970) found that presenting a topic before the testing can also aid recall and recognition.

New Directions for Readability

Recent research in text structure and comprehension has several

important implications for readability theory and practice. First, text-level factors such as coherence and organization must be considered along with word-level and sentence-level factors when evaluating the readability of a specific set of materials or when attempting to construct parallel experimental passages of equal difficulty. More research is needed in order to determine the most useable measure of coherence with the highest predictive value in a given situation. Extensive text grammars for common expository organizational structure are needed and more research should be conducted on the relative difficulty of various organizational types and on the importance of explicit statements of superordinate concepts.

Second, it is clear that a single minded application of any factor to all ages and ability levels is likely to be ineffective. Research indicates that such things as the ability to select the main idea (Brown, Smiley, and Lawton, 1977; Brown and Smiley, 1978; Taylor, 1978) and the ability to make inter-sentential inferences (Bridge, Tierney, and Cera, 1977; Paris and Upton, 1976) develops during the school years. Though sentence length has been shown to be an important variable relating to the reading comprehension of children (Entin and Klare, 1978), it does not seem to have a pronounced effect on mature readers (King and Greeno, 1974; Kintsch and Monk, 1972). Moreoever, the assumption that factors such as referential coherence and relational density which have been related to adult readers' comprehension will also be related to children's comprehension is unjustified. Thus, many of the results described in this paper must be replicated with readers of various ages and ability levels.

Third, the formula approach must be modified. It is clear that such easily measurable factors as sentence length and number of syllables are not necessary determinants of comprehensibility (Irwin, 1978; Rosenshine, 1969). Moreover, these formulae provide teachers with little useful information about what can be done to increase their students' comprehension and retention. What is needed is an extensive description of all the factors that affect comprehension at various developmental stages. Checklists can be developed which guide teachers of various grade levels to identify salient strengths and weaknesses in their classroom materials (Irwin and Davis, in press).

Finally, it must also be noted that text structure alone cannot determine readability. All considerations of readability must also include reader-related factors such as prior knowledge, attitude, and motivation (Asher, Hymel, and Wigfield, 1978; Fass and Schumacher, 1978; Hittleman, 1973; Klare, 1976; and others). Indeed, research on the relationship of text structure and comprehension must further investigate the interaction of text-structure and reader-related variables if readability determinations are to be optimally effective for specific groups of readers and materials.

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